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C-A OPERATIONS PROCEDURES MANUAL

7.1.55 25 kW Helium Refrigerator Pre-Cool

Text Pages 2 through 8

Hand Processed Changes

<u>HPC No.</u>	<u>Date</u>	<u>Page Nos.</u>	<u>Initials</u>
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Approved: _____ *Signature on File* _____
 Collider-Accelerator Department Chairman Date

S. Sakry

7.1.55 25 kW Helium Refrigerator Pre-Cool

1. Purpose

This procedure provides instructions for the pre-cooling of the RHIC 25 kW Helium Refrigerator for contamination removal in two phases. Phase 1 involves cooling the warm end of the refrigerator down to operating temperature. Phase 2 involves pre-cooling the refrigerator cold end.

2. Responsibilities

- 2.1 The Shift Supervisor, or an Operator designated by the Shift Supervisor, is responsible for conducting the procedure and providing documentation in the Cryogenic Control Room Log and in the Cryogenic Valve Log.
- 2.2 Should a problem arise during the completion of this procedure, the Shift Supervisor shall contact the Technical Supervisor for instructions before continuing.

3. Prerequisites

- 3.1 The performance of the refrigerator relies heavily on the system being free of contaminants. Prior to cooldown, the cryogenic system shall be pumped, purged, and scrubbed. For instructions on scrubbing the refrigerator, please reference [C-A OPM 7.1.13](#). The main compressor system shall be lined up and ready for operation.
- 3.2 The Operator shall be trained by the Shift Supervisor.
- 3.3 Operator shall be familiar with the following drawings:
 - Drawing 3A995009 25 KW Helium Refrigerator P & ID
 - Drawing 3A995066 6:00 Yellow Ring P & ID (used with [C-A-OPM-ATT 7.1.55.a](#))
 - Drawing 3A995086 6:00 Blue Ring P & ID (used with [C-A-OPM-ATT 7.1.55.a](#)).
 - Refrigerator Valve Reference Guide
- 3.4 Operator shall be familiar with the physical location of components on the drawings listed under 3.3.
- 3.5 Operator shall be familiar with the control pages found on the CRISP control system.

4. Precautions

- 4.1 Confirm the availability of Particle Accelerator Safety System (PASS) in the refrigeration wing of 1005R.
- 4.2 If there is liquid helium in the refrigerator pots, all personnel entering the refrigeration wing of 1005R must have a personal ODH monitor, must be ODH Class 1 qualified, and carry an emergency escape pack.
- 4.3 This procedure assumes that cooldown of the refrigerator will use HX1A/2A, adsorber bed A, and all “A” string turbines. If HX1B/2B, adsorber bed B, or “B” string turbines are used, valve selection must be adjusted accordingly.

5. Procedure

- _____ 5.1 Align compressor building valves.
- _____ 5.2 Align the hygrometer and oxygen monitor in compressor building to sample compressor discharge.
- _____ 5.3 Verify valve positions as specified in [C-A-OPM-ATT 7.1.55.a](#).
- _____ 5.4 Phase 1
 - _____ 5.4.1 Set the following process valves to the CLOSED position:

H9A	H328A
H33A	H352A
H86A	H385A
H100A	H402A

- _____ 5.4.2 Set the following process valves to the OPEN position:

H38A	H410M
H90M	H810M
H123A	H398M*
H130M	H798M*
H131A	H406M*
H156M	

*The indicated position of these valves has to be manually updated on CRISP page D51.

- _____ 5.4.3 Start main compressors as needed.

atm.

_____ 5.4.4 Select a warm turbine inlet filter and purge per C-A-OPM 7.1.50 "Purge of Warm Expander Inlet Filter".

_____ 5.4.5 Initialization warm turbines 1A, 2A, 3A, and 4A per [C-A-OPM 7.1.40 "Warm Turbines "A" Track Initialization"](#).

_____ 5.4.6 Ensure warm turbine mid pressure is less than 7

_____ 5.4.7 Set turbine vanes as follows:

H330A - Closed

H339A - 15 % Open

H354A - 25% Open

H357A - 25% Open

_____ 5.4.8 Place turbine outlet valve H380A in automatic with a setpoint of 1.40 atm.

_____ 5.4.9 Start warm turbines.

_____ 5.4.10 When #4 turbine outlet temperature at TI361H is less than or equal to 150° K, control helium flow through the cooldown return line so as to maintain a pressure at PT17H (H9A outlet) between 2 - 3 atmospheres by throttling valve H9A.

_____ 5.4.11 In manual mode, put valve H153A at 100% open and open valve H344A 100%.

Caution:

Throughout this procedure, monitor temperature sensor TI3063 on the low pressure return to the compressors. Should TI3063 drop below 270°K, quickly evaluate the bypass configuration.

_____ 5.4.12 Monitor the temperature of the cooldown return flow at TI8H (H9A inlet). When TI8H reads below 150°K open valve H425M.

_____ 5.4.13 Close valve H827M.

_____ 5.4.14 Monitor the temperature of the cooldown return flow at TI8H (H9A inlet). When TI8H reads ~

120°K, close valve H156M and slowly open valve H376M.

_____ 5.4.15 Close valve H425M.

_____ 5.4.16 When the outlet temperature of the on-line adsorber is below 90°K, enable the adsorber logic alarm.

_____ 5.4.17 Monitor the temperature of the cooldown return flow at TI8H (H9A inlet). When TI8H reads ~ 60°K and the adsorber outlet temperature is less than or equal to 80°K, you are ready to go to Phase 2.

_____ 5.4.18 Set H3025A (recovery pump back) in automatic at 1.18 atmospheres. Set the emergency tank fill valve H2918A in automatic control.

_____ 5.4.19 Set valves H153A and H344A in automatic mode.

_____ 5.5 Phase 2

_____ 5.5.1 Set the following valves to the CLOSED position:

H9A	H376M
H130M	H413M
H131A	H813M

_____ 5.5.2 Open valve H827M.

_____ 5.5.3 Control helium flow through the cooldown return line so as to maintain a return pressure at PT129H (inlet of intermediate pot) of 7 to 12 atmospheres by adjusting valve H86A. Maintain turbine #4 and adsorber bed at their normal temperature

_____ 5.5.4 Select a cold turbine inlet filter and purge per C-A-OPM 7.1.51, "Purge of Cold Expander Inlet Filter".

_____ 5.5.5 Initialize cold turbines 5A and 6A per [C-A-OPM 7.1.42, "Cold Turbines "A" Train Initialization"](#).

_____ 5.5.6 Monitor the temperatures of HX5/6. When the outlet temperatures of heat exchanger 5/6 reaches

150°K as read on temperature sensor TI30H,
continue.

_____ 5.5.7 Align path to return by closing valve H410M and
opening valve H409M.

_____ 5.5.8 Start turbines 5A/6A and monitor temperature
sensor TI 408H (#6 outlet temperature).

_____ 5.5.9 Verify control circuit has placed valve H159A
(HX7) in auto control. This is enabled by valve
H406M being open and turbine train running.

_____ 5.5.10 When temperature sensor TI408 (#6 outlet
temperature) is less than TI31H (HX7M H.P.
outlet), crack open valve H410M.

_____ 5.5.11 Slowly continue to open valve H410M and start to
close valve H409M. This step is complete when
valve H410M is fully open with valve H409M
completely closed.

_____ 5.5.12 Open the following valves:

H33A
H58A
H130M

_____ 5.5.13 Close valve H38A.

_____ 5.5.14 Set valve H95A in automatic at 2.5 ATM.

_____ 5.5.15 In manual, open valve H100A slightly to maintain
less than or equal to 2 atmospheres of pressure in
the pots.

_____ 5.5.16 Set the following valves to the OPEN position:

H5M	H238M
H26A	H4643A
H123A	

- _____ 5.5.17 In manual mode, set valve H54A to 50%.
- _____ 5.5.18 Monitor temperature sensor TT228H and TI233H. (TT228H is located before valves H123A and H130M, and TI233H is located between valves H40A and H69A.) When TT228H and TI233H reach 180°K, open valve H425M slowly. This step will take some time because of the low flow rate.
- _____ 5.5.19 Close valve H827M.
- _____ 5.5.20 Continue to monitor temperature sensors TI228H and TI233H. When TI228H and TI233H reach 50°K open valve H157M.
- _____ 5.5.21 Close valve H425M.
- _____ 5.5.22 Using the calorimeter, balance and maintain the refrigerator in this configuration.
- _____ 5.5.23 The refrigerator will be used for pre-cool of ring (see [C-A-OPM 7.1.53, "RHIC Ring Pre-Cool via Heat Shield Supply"](#)).

6. **Documentation**

- 6.1 The check-off lines on the procedure are for place-keeping only. The procedure is not to be initialed or signed, it is not a record.
- 6.2 The Shift Supervisor shall document the completion of the procedure in the Cryogenics Control Room Log

7. **References**

- 7.1 Drawing 3A995009, 25 kW Helium Refrigerator P&ID.
- 7.2 Drawing 3A995066, 6:00 Yellow Ring P&ID.
- 7.3 Drawing 3A995086, 6:00 Blue Ring P&ID.
- 7.4 Refrigerator Valve Reference Guide.
- 7.5 [C-A-OPM 7.1.40, "Warm Turbines "A" Train Initialization"](#).
- 7.6 [C-A-OPM 7.1.50, "Purge of Warm Expander Inlet Filter"](#).

- 7.7 [C-A-OPM 7.1.51, "Purge of Cold Expander Inlet Filter".](#)
- 7.8 [C-A-OPM 7.1.42, "Cold Turbines "A" Train Initialization".](#)
- 7.9 [C-A-OPM 7.1.53, "RHIC Ring Pre-Cool Via Heat Shield Supply".](#)

8. Attachments

- 8.1 [C-A-OPM-ATT 7.1.55.a " Valve Position Tables".](#)